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UTILIZATION OF SIDOARJO MUD AS THE RAW MATERIAL OF MAKKING PORTLAND CEMENT

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Abstract

Portland cement is generally made of clay, lime, iron sand, silica sand and alumina sand, In this research, the manufacture of cement by using the material in the form of Sidoarjo mud because it has a clay content that resembles that of 2,34% CaO, 6,52% Al_2O_3, SiO_2 Fe_2O_3 67,63% and 4,88%, making it possible to make an manufacture of Portland cement with addition of CaO and through the combustion process, Research done by mixing mud in Sidoarjo in chalk in some variation ratio of 40:60; 37,5:62,5; 35:65; 32,5:67,5 and 30:70, After a homogeneous mixture and then baked in the furnace at a temperature variation 1200^oC with the time allowed is 60, 90, 120, 150 and 180 minutes, Cement is then the compressive strength test and analyzed levels of the chemical, Retrieved best conditions on a comparison between proportion of Sidoarjo mud and lime 30:70, 3 hours burning time and compressive strength value of 13,00 kg / cm^2 for ages 3 days and 15,08 kg / cm^2 to age 7 days,

Key word : *portland cement,lime stone,Sidoarjo mud,*

INTRODUCTION

Mud volcano phenomenon that occurred in the village of Siring,Porong,Sidoarjo regency result of gas drilling wells Banjarpanji Renokenongo-1 in the Village that have occurred since the date of May 29, 2006, is still ongoing, The volume of mud coming out of the bowels of the earth continues to increase annually, from about 5,000 in June 2006 m3/day to 50,000 m3/day by the end of 2006, and continued to increase to 100,000 to 120,000 m3/day in 2007, Until now, still there are signs that the mud will stop (BPLS, 2009),Sludge is composed of various materials,TotokNoerwarsito (2007) from the ITS presented that outlines the characteristics of mud containing clay 71,43%, silt 10,71% and 17,86% sand,Another source of Tekmira (2007) mentions that the main content of the Sidoarjo mud is clay by 40-45%, (BLH East Java Province, 2007),According BPLS (2009),Sidoarjo mud contains almost the same clay used as raw material for portland cement is composed of CaO, Al2O3, SiO2, and Fe2O3, The content of CaO in Sidoarjo mud is too small when compared with the required cement content while Al2O3, SiO2, and Fe2O3 is sufficient to meet, so that the Sidoarjo mud could potentially be used as materials for portland cement with the addition of limestone,The chemical composition of sludge Sidoarjoisanalyzedin comparison toportlandcementcan be seenin Table1,

Tabel 1,Sidoarjo mud comparison with the chemical composition of Portland cement

Compound	Compotion	
	Sidoarjo mud	Portland cement
Silikat (SiO_2)	67,63 %	19 - 25 %
Ferumoxide (Fe_2O_3)	4,88 %	0,3 – 6 %
Aluminium oxside (Al_2O_3)	6,52 %	2 – 8 %
Calsium oxide (CaO)	2,34 %	60 – 65 %

Resources: H,N Banerjea, 1980

Manufacture of cement made by mixing mud in Sidoarjo and limestone and then burn it, thus forming portland cement,
Cement ("caementium" = binder), the definition in general is an adhesive that can bind the solid ingredients into one powerful entity (Rohmawati, H,, 2002), Ash or Cement Portland cement is a powder / bulk bluish gray color, made of limestone or limestone and clay or clay,Limestone is the result of mine-containing compounds of calcium oxide (CaO), while the clay contains silica dioxide (SiO2) and aluminum oxide (Al2O3),Both materials are then subjected to melt the combustion process,(Pratomo, A,, in Tedifa, 2007), According to George T,Austin (1996),portland cement is defined as the product obtained from the fine grinding clinker consisting primarily of hydraulic calcium silicates and contains one or two forms of

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calcium silicate as an additional antargiling, This type of cement based on SNI 15-2049-2004 consists of five types: type I (ordinary portland cement), cement type has high levels of C2S and C3A 10% - 15% and a hydraulic cement that is used extensively for general construction does not require any special requirements such as residential buildings, high rise building bridges, runways and highways,Type II (moderate heat cement), having high levels of C2S and C3A 6-7%, Cement types are often used for building the waterfront, irrigation and for casting the concrete mass and dams that require resistance to the influence of sulfate and heat of hydration medium,Type III (high early strength cement), has a high content of C3S and very finely granulated,Cement is used for buildings that require a high initial pressure after casting done and requires the completion of that as soon as possible,Whiskers for a high-rise buildings, concrete roads, bridges and airports as well as heavy machine foundation,Type IV (low heat cement), Used for low heat of hydration, minerals have a composition of 26% C2S, 50% C3S, C3A 5% and 12% C4AF, Used for casting and spraying, Type V (sulfate resistance cement),portland cement with high sulfate resistance, including resistance to sulfate salt solution in water, Cement is used for construction of buildings on the land / water containing high sulfate and is perfect for the sewage treatment plant, construction of water, bridges, tunnels, ports and nuclear power plants,Requirements of physics and chemistry of portland cement can be seen in Table 2 and Table 3.
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Table2,Physics requirements of portland cement

Description	Type of cement				
	I	II	III	IV	V
Fineness of the air Permeabilitytest m^2/kg with a :					
turbinmeter,min	160	160	160	160	160
Blaine,min	280	280	280	280	280
	-	-	-	-	-
Viscocity :					
Expansion dengan autoclave,max %	0,8	0,8	0,8	0,8	0,8
Compressive strength at 1 days age,kg/cm^2,min	-	-	120	-	-
Compressive strength at 3 days age,kg/cm^2,min	125	100	240	-	80
Compressive strength at 7 days age,kg/cm^2,min	200	175	-	70	150
Compressive strength at 28 days age,kg/cm^2,min	280	-	-	170	210

Resources: SNI 15-2049-2004

Tabel 3,Chemical requirements of portland cement

Uraian	Jenis semen portland				
	I	II	III	IV	V
SiO_2,min	-	20	-	-	-
Al_2O_3,max	-	6	-	-	-
Fe_2O_3,max	-	6	-	6,5	-
MgO,min	6	6	6	6	6
SO_3,max					
$C_3A \leq 8$	3		3,5	2,3	2,3
$C_3A > 8$	3,5		4,5		
Lost incandescent,max	5	3	3	2,5	3
The insoluble,max	3	1,5	1,5	1,5	1,5
C_3S,min	-	-	-	35	-
C_2S,min	-	-	-	40	-
C_3A,max	-	8	15	7	5
$C_3AF + 2C_3A$ atau $C_4AF + C_2F$,max	-	-	-	-	25

Resources: SNI 15-2049-2004

Manufacture of cement can be done with 2 (two) ways: first, the wet process, all raw materials are mixed with water 30% - 40%, crushed and vaporized and then burned with fuel, This process is rarely used because of the limitations of energy (fuel), Second, the dry process, the stage of milling and mixing is done dry (moisture content 5%), The clay is dried in advance and mixed materials are then used as bait for the dry combustion stage, The next process with wet process,
This study aims to find the burning time and the comparison of proportions between Sidoarjo mud with limestone is best viewed from the value of compressive strength,

METHODOLOGY

Materials and tools,

Materials used in this study is Sidoarjo mud that is still untapped by the community,Sidoarjo mud mud embankments was taken in the area north of the Village Renokenongo center Sidoarjo mudflow,

Auxiliary materials used are limestone and aquades from store chemicals in Surabaya, While the tools used in this study is 1200°C temperature furnaces, ovens, digital scales, mortar, sieve 200 mesh and compressive strength test equipment, The treatments set is the temperature of combustion: 1200°C,The treatments run the comparison of proportions between Sidoarjo mud with limestone (wt%): (40:60), (37,5:62,5) (35:65), (32,5:67,5); (30:70) and burning time (minutes): 60; 90; 120: 150; 180,

Research Procedure

Preparation

Limestone crushed and then sieved with 200 mesh size and Sidoarjo mud dried in an oven at a temperature of 100oC to constant weight, crushed and then sieved with 200 mesh size to match the size,

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Cement manufacture

Sidoarjo mud limestone and mixed until homogeneous with various proportions according to the prescribed treatment,Subsequently burned in the furnace at a temperature of 1200oC and appropriate treatment time, Then cooled and sieved with 200 mesh size,

Compressive strength test

Cement printed cylindrical with a diameter = 3,5 cm and height = 7 cm with a ratio of cement mortar composition was made permanent,ie ratio of cement: sand = 1: 3 (volume ratio),Subsequently analyzed compressive strength with age 3 and 7 days,

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RESULTS AND DISCUSSION

Cement mixed with sand that has formed and the water then printed cylindrical with a diameter of 3,5 cm and height 7 cm,After the age of 3 days and 7 days were tested strongly compressed

Table4, Test results of compressive strength of cement at the age of 3 days

Proportion of Sidoarjomud : batukapur	Kuattekan(Kg/cm^2)				
	w aktu 1 jam	w aktu 1,5 jam	wa ktu 2 jam	w aktu 2,5 jam	w aktu 3 jam
40 : 60	4,37	5,30	6,45	7,28	7,38
37,5 : 62,5	5,10	6,24	6,86	7,70	7,90
35 : 65	5,82	7,18	7,59	8,11	8,32
32,5 : 67,5	6,45	7,80	8,32	8,84	9,15
30 : 70	7,49	9,36	10,61	11,54	13,00

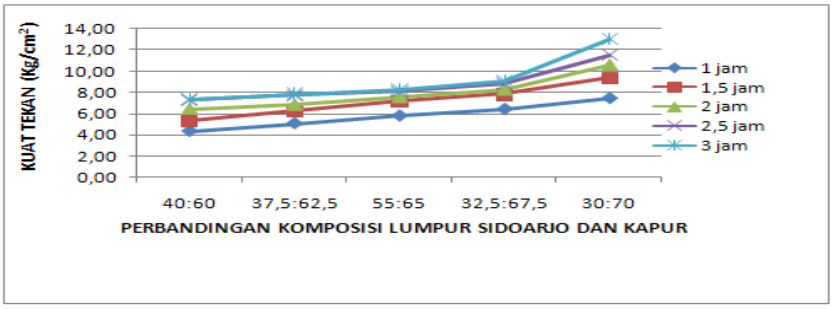

Figure 1.The relationshipbetween the proportion ofSidoarjomudandlimestonewith acompressive strength (age3 days)

Table5,Compressive strengthtest resultsat age7 days

ProporsilumpurSidoarjo : limestone	Compressive strength(Kg/cm^2)				
	Time : 1 hour	Time : 1,5 hour	Time : 2 hour	Time : 2,5 hour	Time : 3 hour
40 : 60	5,51	6,76	7,28	7,59	8,32
37,5 : 62,5	6,45	7,28	7,90	8,32	8,63
35 : 65	7,18	8,01	8,63	9,36	9,57
32,5 : 67,5	8,32	8,63	9,57	10,09	10,40
30 : 70	10,42	11,23	12,48	14,14	15,08

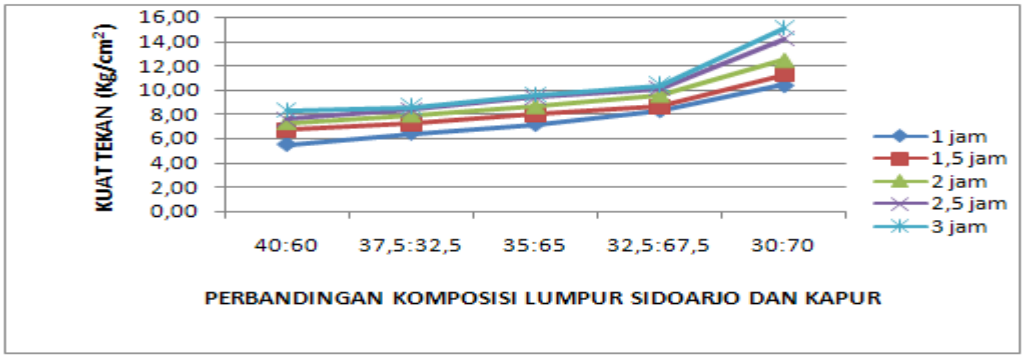

Figure2.The relationshipbetween the proportion ofSidoarjomudandlimestonewith acompressive strength (age7 days)

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compressive strengthtest resultsobtainedthe largestvaluefound inthecomparison ofproportions ofcementandlimemud in Sidoarjo30:70with3 hoursofburning timeforages313,00kg/cm215,08kg/cm2forthe dayand7 daysold,Furthermore, toprove thecontentofC3S,C2S,C3A,andC4AFcontained incementperformedchemicalanalysisfollowed bycalculationin accordancewith the formulacontainedin theSNI15-2049-2004,

Table6,Results of analysis ofthe chemicalcompositionofcementin the proportion30:70Sidoarjomudand theburning timeof 3 hours,

Test Parameters	Test result
Silikat (SiO_2)	18,18
Besioksida (Fe_2O_3)	0,89
Aluminiumoksida (Al_2O_3)	0,3651
Kalsiumoksida (CaO)	40,96

Table7,Comparison ofcompressive strengthtest resultswith the largestSNI

Umur (hari)	Hasilujikuattekan (kg/cm^2)	SNI 15-2049-2004				
		Tipe I	Tipe II	Tipe III	Tipe IV	Tipe V
3	13	125	100	240	-	80
7	15,08	200	175	-	70	150

Resources: SNI 15-2049-2004

Furthermore, toprove thecontentofC3S,C2S,C3A,andC4AFcontained incementperformedchemicalanalysisfollowed bycalculationin accordancewith the formulacontainedin theSNI15-2049-2004,

Table8,Results of analysis ofthe chemicalcompositionof cementfrom theSidoarjomudwith a ratio ofthe proportion of30:70withburning time3 hours

Uraian	Hasilanalisa	SNI 15-2049-2004				
		Type I	Type II	Type III	Type IV	Type V
SiO_2, MIN	18,18	-	20	-	-	-
Al_2O_3, MAX	0,3651	-	6	-	-	-
Fe_2O_3, MAX	0,89	-	6	-	6,5	-
C_3S, MIN	24,85	-	-	-	35	-
C_2S, MIN	33,37	-	-	-	40	-
C_3A, MAX	0,538	-	8	15	7	5
$C_4AF + 2C_3A$, MAX	52,41	-	-	-	-	25

Resources: SNI 15-2049-2004

Figure 1 and Figure 2 shows that the compressive strength gained more in line with the rising proportion of mud in Sidoarjo: limestone, This is caused by the increase in CaO, where CaO is a chemical that has a function as an adhesive / binder (Wiryasa and Sudarsana, 2009), With increasing CaO content of the adhesion of cement also increased so that the compressive strength obtained is also getting bigger, in Figure 1 and Figure 2 also shows that the greatest compressive strength shown on the longest burning time is 3 hours, This is caused by the increased burning time then the compounds are very influential on the compressive strength of cement such as C3S, C2S, C3A and more formed when compared with that found in semen that burned with a shorter time, (Lea, FM, 1970) , In the picture also looks pretty extreme increase occurred in comparison 30: 70 because the ratio is already close comparison of the actual cement raw materials with 20% clay and 80% lime (Windi and Dody, 2009), The results of calculations obtained C3S is positive indicating that in these compounds C3S cement is formed, This happens because the new C3S began to form at temperatures 1200oC and fully formed at temperatures above 1260oC to 1450oC, C2S showed significant positive value since the C2S 1200oC temperature maximum has been formed, C3A showed positive values due to the temperature 1200oC most of C3A was formed, C4AF showed a positive value because the majority of C4AF 1200oC temperatures have started to form, (Lea, F,M, 1970), Table 7, shows that the compressive strength values obtained are very small when compared with the standard contained in the SNI 15-2049-2004, This can occur because of C3S are very influential on the compressive strength has not been fully formed and the content of CaO that serves as an adhesive substance is also not meet the standard for portland cement,

CONCLUSION

The bestconditionsthat producethe greatestvalue ofthecompressive strengthof 13kg/cm2for3days and15,08kg/cm2for theage of7 daysis obtainedon the proportionbetweenSidoarjomudandlimeSTONE30:70with aburning timeof 3 hours,Compressive strengthvaluesobtained bycomparisonwithSNI15-2049-2004ranging fromtypeI totype Vare not yet qualifiedbecause ofC3Sarevery influentialon thecompressive strengthhas not beenfully formedand thecontent ofCaOthat servesas anadhesivesubstanceis alsonot meet thestandardforportlandcement,

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